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Abstract

DEVELOPMENTS IN THORIUM PRODUCTION TECHNOLOGY

by K.J. Bril and P. Krumholz*

Recent development in the processing of thorium bearing ores and in the production of nuclear grade thorium oxide are reviewed with special reference to industrial and pilot plant experience in Brazil.

The alkaline process for breaking up monazite, as practiced in Brazil since 1948 on an industrial scale, presents from the point of view of thorium recovery, considerable advantage over other methods. In particular, yields are practically quantitative, separation factors of thorium from rare earths and phosphate are of the order of 100, and thorium is obtained in a form very suitable for solvent extraction purification. Working conditions, which allow obtaining satisfactory results under economic conditions, are presented.

Solvent extraction purification of thorium is discussed with special emphasis on: a) slurry extraction, b) thorium decontamination from rare earths and c) separation of thorium and uranium.

* Instituto de Energia Atômica, São Paulo, Brazil and
Research Laboratory of Orquima S.A., São Paulo, Brazil.

Pilot experience with slurry extraction in mixer-settlers is reported. Emulsion formation in the extraction of unfiltered solutions of the crude thorium product from alkaline attack of monazite is prevented by the use of active carbon as de-emulsifying agent.

Satisfactory decontamination of thorium from the rare earths, which constitute the main impurity (10%) in the crude thorium product, presents some peculiar problems if the scrubbing operation is performed in pulsed extraction columns. Whereas increasing thorium concentrations in the tributylphosphate solvent improves the thorium-rare earths single-stage separation factors, it severely reduces the rate of transfer of the minor constituents into the aqueous phase, resulting in high H.E.T.S. values.

Highly efficient thorium-uranium separation is obtained by using an extractive - precipitation procedure, which consists in contacting the solution of thorium nitrate in the organic solvent with a 20 - 30 % sulfuric acid solution. Thorium is simultaneously extracted and precipitated as sulfate, which remains wholly in the aqueous phase. Thorium - uranium separation factors of up to 20.000 are obtained in a single-stage operation. Appreciable decontamination of thorium from many other elements is achieved at the same time. A further advantage of the extractive precipitation procedure is the possibility of an easy recovery of the nitric acid, which can be recycled into the original dissolution process of the crude thorium concentrate.

After the transformation of thorium sulfate into a basic carbonate, a high purity thorium oxide is obtained by calcination.

Alternatively, conditions have been established for the direct precipitation of thorium oxalate from solutions of thorium nitrate in the organic solvent.